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ABSTRACT

Much early research regarded television as a static medium, and it ignored the process of the information delivery and its match with the cognitive style of the viewer. Information processing should be looked at from the dual perspective of eye movement research and the degree of locus control. To uncover the interrelationships of efficient eye scanning, internal control, and learning, a research model has been conceived which will test how much comprehension results when samples combining varying degrees of internal control and eye movement are exposed to different media presentations. (EMH)

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STUDY SERIES 4

A DEVELOPMENTAL LOOK AT EYE MOVEMENT PATTERNS OF INTERNALLY AND EXTERNALLY CONTROLLED CHILDREN WATCHING TWO INSTRUCTIONAL MODES

by

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Introduction

Concerned only with analyzing television as an unmoving and undynamic mode of instruction, researchers in the past have tended to overlook the fact that it is a variable medium that can be so produced to fit particular instructional functions and in so doing provide a most suitable means for directed ~~individualizing~~ instruction. The realm of educational television has been discussed in terms of learning theories and functions of instruction, the individual learner, and production techniques. Although researchable entities in themselves, in terms of present and future research and theorizing on the impact of instructional television, they are seen as a three-way interaction which makes up a media package or what Allen (1971) calls a foundation for a theory of instructional media.

Lumsdaine (1968) states that instructional media research is basically research on learning. Therefore television as a teaching device must have incorporated within its medium those necessary instructional procedures that any good teacher would follow. Snow and Salomon (1968) take this point one step further by stating that instructional technology must be conceptualized as some combination of learning theory and individual differences. This theory is based on the premise that both media and the individual learner have certain attributes specific to them and through aptitude-treatment-interaction, the best fit between these attributes is found. Recent research (Gagné, 1970; Salomon & Snow, 1968; Snow

& Salomon, 1968; Salomon, 1972) stresses the importance of the three-way interaction between the medium, the individual learner, and the learning task, taking into account both theories and variables of learning and the learner, production principles and variables, and the structure of the learning task. This seems to be the direction that research in educational television is now taking in order that more valid conclusions can be drawn about the medium than had been made in the past.

"Learning is, after all, an individual matter, in which essential idiosyncratic elements must be supplied by the learner himself." (Gagné, 1970, p. 62) In his discussion of learning and the individual, Gagné suggests that a student can contribute to his own learning by establishing conditions of learning and functions of instruction to suit his own needs. As most learning theories state, learning occurs when the student himself imposes on a task some form of intellectual processing whether it be called mediation, coding, or set. Naturally the stimuli presented to the learner are an important aspect of learning as a whole, but it is how the student processes these stimuli that leads to so many individual differences in achievement. For this reason methods of instruction must focus on the individual student and what better way of doing this than by means of television which has almost boundless properties for satisfying the prerequisites for individualization. This is supported by Fowles and Voyat (1974) who state that television must provide

relevant learning experiences to a broad range of viewers.

The above discussion leads to the question of cognitive style and how various modes of information processing affect the capabilities of an individual learner. Psychological theory has it that individuals process information according to the cognitive structures that they have acquired through experience. In their discussion of aptitude-treatment-interaction, Salomon and Snow (1968) elaborate on this by stating that individual learners approach a given task according to aptitudes characteristic of them. The question at hand is how the various media can be so produced to alter these existing structures and at the same time enable the individual learner to react differently to new stimuli. As Nunney and Hill (1974) point out, cognitive style is not immutable. According to them, the important thing is to match the cognitive style of the student to the style of the mode of presentation of information and by so doing, gear the media presentations to the individual strengths and weaknesses of the individual learners. Cooney and Allen (1964) examined the nonlinear relationships among humans and their informational environments and concluded that "the development of a learning experience might be optimally controlled by precise placement of cues designed to shift the emotional and logical frames of reference of the learner" (p. 318).

Several theoreticians in the field of media are now calling for relevant research based on the above premise concerning the

interaction between those intellectual capabilities of individual students and those elements peculiar to television or other media. In calling for bases for future research Anderson (1972) states that "the relationships of visual television communication techniques to theoretical models of perception and learning ought to be investigated more thoroughly than in the past. There should be a conscious attempt to link production techniques to specific roles they might play in aiding particular types of learning with specific types of behavioural objectives (p. 61). His statement summarizes the feelings other educational communicators (Lumsdaine, 1968; Allen, 1971; and Meichenbaum, 1972) have expressed concerning the directions that research in the field should take.

It is these feelings about the direction that research in the area of educational media should take that has stimulated the following research proposal. This study will concern itself with describing, through eye movement research, the information-processing that takes place between individuals possessing a certain cognitive capacity relevant to their degree of Locus of Control and relative age, as they view television and a static medium such as slides or film strips.

Locus of control is a fairly new concept in the domain of cognitive styles, but lately has attracted much research attention. Locus of control is the extent to which the individual perceives that it is his own behaviour which determines what happens to him

(Stephens, 1973). Rotter's (1966) discussion further implies the definition of locus of central expectancies - "internal control" which is the extent to which an individual perceives his fate to be an outcome of his own actions, and "external control" or the extent to which one perceives his fate as being determined by chance or the whims of others (Shipe, 1971).

"It is assumed that a child's tendency (probability) of associating the occurrence of a reinforcement with his own behaviour, rather than with some other event or condition, may reflect the degree to which he perceives his behaviour as the primary contingency for that reinforcement and therefore the (subjective) probability of the contingency of that reinforcement on his behaviour" (Stephens and Delys, 1973A, p. 56). Stephens and Delys have come to the preceding conclusion in the light of their research on the antecedents of feelings of locus control in preschool children. Furthermore they sight (Stephens and Delys, 1973B) the results of the Coleman report (Coleman, 1966) on the equality of educational opportunity in which it is concluded that children's feelings of being able to affect their environments and futures is more important than all school factors put together.

A major conclusion that Stephens has come to that is relevant to this study is that the development of internal control expectancies is correlated with cognitive-intellectual development (Stephens, 1970, 71, 72, 73). This, he states, could mean either that faster development

of internal control expectancies could accelerate intellectual development; that the reverse is true, that because of their faster intellectual development children sooner acquire internal control expectancies; or that both or neither is true. He suggests a safe expectation however - that Internal-External (IE) development and intellectual development tend to enhance each other in more of a symbiotic than parasitic relationship. An important conclusion however is that IE control seems to "affect the rate of acquisition of successful problem-solving strategies, of schemata, and of various cognitive contents, processes, and skills" (Stephens, 1970, p. 2).

Stephens describes research relevant to the establishment of compensatory or preschool environment intervention techniques based on instilling those elements of internal control into disadvantaged children. As a result of this research he and Delys have delineated those parental and teacher variables that have proven successful in doing so (Stephens et al, 1971). He has shown that "indirect control" is more successful than "direct control" techniques for teachers in instilling internal control expectations in children (Stephens, 1971) and that encouragement, attentiveness, and cooperativeness are a few of the relevant maternal variables (Stephens, 1973). Interestingly enough, Crandall (1973) has found that internality at later developmental stages is best facilitated by external environmental variables that are antithetical to those that instill internal expectancies in younger children.

A major result of Stephens's research in relation to what has been so far discussed in terms of instructional media and individualizing instruction is that he has shown that ways can be found to experimentally increase the rate of internal control expectancies in young children which can lead to an enhancement of cognitive development. Certainly television or other forms of instructional media could play a key role in relation to this finding if more was known about the cognitive processes involved in relation to IE control expectancies and the reinforcement contingencies that so affect these mediating processes.

Other findings relevant to the conclusion that locus of control is related to cognitive development that have evolved from recent locus of control research are that scores in the direction of internal locus of control are shown to increase with age (Shipe, 1971); that IE control correlates positively with academic achievement (McGhee and Crandall, 1968; Reimanis, 1970; Chance, 1968); that internal control correiates positively with both persistence on intellectual tasks and reflectivity (Crandall, 1970); and that IE control is related to attention deployment and the tendency to seek information (Davis and Phares, 1967) and to use information (Phares et al, 1968). Furthermore, as reported by Stephens (1972), Poindexter has indicated a significant correlation between IE control and the Slossen IQ test.

It is the Davis and Phares conclusions that are of major

concern to this study, and through eye movement research more insights will be gained as to the effect of IE control and the attentional variables that play a key role in the interaction between the individual learner and the mode of instruction.

The proposed research is based on the underlying assumption that a child's eye fixations reflect his cognitive approach to the task and that eye movements are indicative of attending behaviour (Fleming, 1969; Mackworth and Bruner, 1966). In the same fashion Yarbus (1961) has concluded that it "is natural that the sequence and duration of fixation on the elements of the object are determined by the process of thinking which accompanies the interpretation of the information. Hence people that think different, see different" (p. 53).

Furthermore, Vurpillot (1968) has found that children under six years of age scan only a limited part of each stimulus, thus making judgments on insufficient evidence. She found, and describes her findings in relation to Piagetian theory, that children under six are unable to relate to the different parts of the object to be perceived which leads to poor differentiation of the elements. She describes the perceptual strategies of young children as being "syncretic" or lacking in coordination between analysis and synthesis. It is therefore important for relevant stimuli to be highlighted in the stimulus field in order to facilitate learning, particularly in younger children. Collins (1970) study on the learning

of essential and non-essential content in a media presentation supports this latter statement. Collins found that learning of essential content increases as a linear function of age. In other words, selective attention seems to be a developmental process. This is consistent with Piagetian theory that predicts an increase with age of the extent in time and space of the range of perceptual activity. As Fowles and Voyat point out in relation to Piagetian theory, a child who transcends the preoperational to the more abstract ways of thinking, also moves from a more egocentric to an objective point of view perceptually. They also point out that any mode of instructional presentation must take into account the fact that not all children viewing a program are at the same level of cognitive development, and that how they respond to a media presentation is very much dependent on some specific situation internal to the individual. These latter statements concerning perceptual development also have relevance to the study of IE control particularly in relation to Piaget's theorizing on egocentrism in the younger child.

As other researchers have done (Tinker, 1958; Taylor, 1965; Yarbus, 1961; Gould, 1973; Nunnally, 1973; Drake, 1970; and Fleming, 1969, for example), Vurpillot uses the number of eye fixations as an estimation of the amount of information collected during the exploration of the stimulus, and it is those areas high in informativeness where more fixations are concentrated (Mackworth and Morandi, 1967; Guba et al, 1964). Adequate scanning strategies are

exemplified by eye fixations, that are concentrated in the high information areas. The reverse would be true of inadequate information - processing or encoding strategies as was shown by Briggs (1973), and O'Bryan and Silverman (1972). Improved reading skill results in fewer fixations, fewer regressions, shorter span of fixation, increased span of recognition per fixation, and increased rate of comprehension (Tinker, 1958). However, it must be remembered, as pointed out by Taylor (1965) that eye movements are only descriptions of good or poor reading strategies, not a cause or effect of reading ability. Their utility lies in their ability to discover how an individual attacks a problem, how he/she distributes effort in problem-solving, and how he/she might change a strategy in the course of a solution. As Fleming points out, "eye movements lead to a theoretical interpretation of research data and a practical prognosis of what might improve the 'readability' of a message" (p. 396). Furthermore, and this can be interpreted in relation to this propcsed study in particular and to the production and evaluation of instructional media in general, Fleming feels that eye movements are useful indicators of whether a designer of an instructional program has fulfilled his objectives or whether a researcher has met his hypotheses.

In relation to the aspects of locus of control previously discussed and to be studied here, some interesting findings are sighted in the literature on eye movements. Faw and Nunnally (1967)

found that not only did eye movements covary with stimulus characteristics such as complexity and novelty, but they also were related to the affective tone of the stimulus field. This finding has important implications when discussing the stimulus characteristics and motivational variables that affect attention, particularly in relation to IE control as it relates to the affective value of stimuli in the visual field. In discussing their results, Faw and Nunnally call for further research into the developmental aspects that might influence affective tones and informational value.

Concerning eye movements and media, Guba, Wolf, de Groat, Kremeyer, Van Atta, and Light (1964) base their research on the premise that "children have certain 'natural' eye movement patterns which they utilize in learning from the television medium and that different modes of visual presentation utilize these patterns more or less advantageously" (p. 387). They feel that individual differences are reflected in eye movement patterns. A most important conclusion to their research, and relevant to this study, is their feeling that eye movements come very close to a physiological indicator of intelligence. Based on this assumption and a previous one made in relation to IE control and intelligence, this study holds some interesting findings to be discovered through a description of eye movements.

The original premise of Guba et al sighted above is the basis for another aspect of this study - i.e. comparing two modes

of instruction by means of eye movement analysis. One value of eye movement studies, as mentioned by Wolf (1971), is that they can be indicative of how an individual responds to various stimulus materials. Past research comparing the various medium as methods of presenting visualized instruction have been inconsistent in their conclusions although it is generally acknowledged that no significant differences exist between the effectiveness of two or more visual media (Dwyer, 1973; Jamison, Suppes and Wells, 1974). Dwyer presents some fairly outdated research comparing filmstrips and television of which filmstrips proved to be the most effective mode of instruction. However since this research, there have been many changes in the production techniques of television that have proven to be able to make important or relevant cues more salient to a learner. Dwyer does conclude, though, that the methods of presentation used in his study (television, slides, programmed instruction) are <u>not</u> equally effective in presenting visualized material. In their review, Jamison, Suppes, and Wells put the blame for the "no significant difference findings" on experimental designs that impose such stringent controls on the formats used to present the content across the various media that everything but the medium is being held constant. They do suggest however that further research into a comparison of the various modes of instruction should concern itself with the long term effects of individualization. This point is also stressed by Snow, Tiffin, and Seibert (1965) whose findings suggests that different methods

of teaching the same subject matter can be facilitory or inhibiting depending on the characteristics of the learners that interact with the methods of presentation. Allen and Weintraub (1968) suggest that the motion variable peculiar to a televised mode of presenting visual stimuli is more effective because of production techniques that aid in the differentiation of relevant stimuli. Computer bridging is an excellent example of television's ability to guide eye movements. Finally, on the subject of various modes of presentation, it must be remembered that no valid comparison between modes of presentation can be made unless the content of the instruction is established as equivalent across modes.

Hypothesis

In light of the preceding statements on modes of instructional presentation, eye movements, perceptual development, and locus of control, the following hypotheses have been formulated:

(1) Older children will exhibit more efficient scanning strategies and will comprehend better than will younger children.

(2) Internally controlled children will exhibit more efficient scanning strategies and will comprehend better than will externally controlled children.

(3) A televised presentation will yield more efficient scanning strategies and better comprehension for the externally controlled individuals, than will a static presentation.

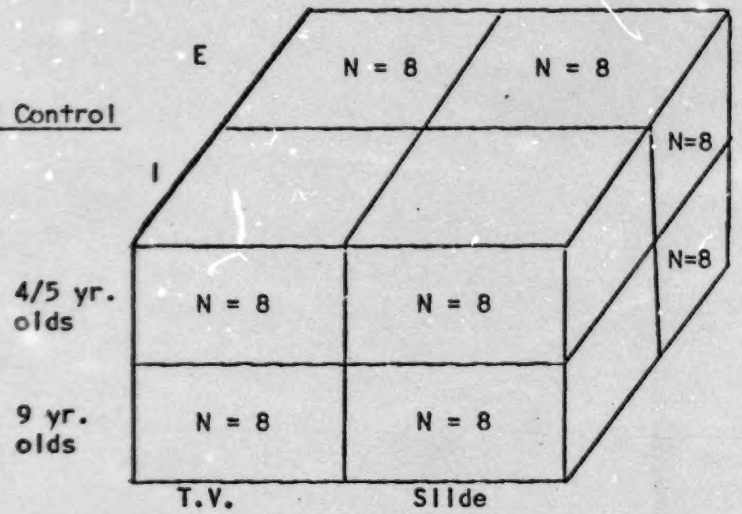
(4) There will be no difference across modes of presentation in the scanning strategies and comprehension of internally controlled individuals.

(5) Efficient scanning strategies lead to better comprehension of program content.

Procedure

Subjects and Design

Subjects will be sixty-four children equally split on age, locus of control, and mode of presentation. The design is a 2 x 2 x 2 with eight subjects in each cell as diagrammed:



Method

Segments from the CTW program Electric Company are to be used as the stimulus. It has been demonstrated that preschoolers are attracted to certain segments of Electric Company (Graham, 1973) and it is these segments that are to be used in this study. In order to insure similar content over presentations, a slide presentation using the visuals from the television program concurrently with the same voice over will be designed for the purposes of this study.

Subjects will be pre-tested on degree of locus of control,

intelligence, and knowledge of program content. Locus of control will be evaluated by means of the SDRCI, a Locus of Control measure specifically designed by Stephens and Delys for preschoolers and children. The subjects will then be assigned to their respective cells (see diagram) and presented with the visual presentation. Eye movement recordings are to be simultaneously taken by means of a Mackworth eye marker recorder (Mackworth, 1967). The eye movements will be analyzed, using a computerized method being presently worked out by Henderson and Mock, to determine which cells viewed the important elements of the presentation. Efficient information-processing strategies are to be defined by clustering of eye movements in the relevant areas of the visual field, and the direction of eye movements (Briggs, 1973). A post-test on program content will be given to the groups to assess any interactions between comprehension and eye movements. Thus two dependent variables, eye movement recordings and a measure of program content comprehension are to be employed in this study.